

## **PROGRAM ANNOUNCEMENT**

- Theme 2005 - Materials Engineering for Affordable New Systems II (MEANS2).
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### **AFOSR BAA 2004-2**

#### **PROPOSAL DEADLINE:**

3:00 p.m. Eastern Daylight Time  
Thursday, 12 August 2004

## **OVERVIEW INFORMATION**

- **Agency Name(s)** – This program will be administered through the Air Force Office of Scientific Research (AFOSR).
- **Funding Opportunity Title** – Theme 2005 - Materials Engineering for Affordable New Systems II (MEANS2).
- **Announcement Type** – This is the initial announcement.
- **Funding Opportunity Number** - AFOSR BAA 2004-2.
- **Catalog of Federal Domestic Assistance (CFDA Number(s))** - 12.800 -- Air Force Defense Research Sciences Program
- **Dates** – Proposers Conference – 3 May 2004.
  - Letters of Intent – 1 June 2004.
  - Proposals should arrive by 3:00 PM Eastern Time, 12 August 2004.
- **Additional Overview Content** - To develop validated and verified design methodologies that employ materials modeling and strategic experimentation spanning length and time scales from individual atoms to engineering structures, emphasizing compatibility between models at adjacent scales, interoperability with systems design software, lifetime prediction and uncertainty modeling.

## I. Funding Opportunity Description

### MATERIALS ENGINEERING FOR AFFORDABLE NEW SYSTEMS II (MEANS2)

**Background:** Over the last twenty-five years, developments in computer-aided design and manufacturing have dramatically reduced the product cycle time from initial concept to finished component. During this same period progress in the development of materials and processes that enhance the performance and life expectancy of components has not kept pace with these developments. The interface between engineering design and materials science and engineering remains a collection of empirically developed and verified material property databases obtained by *ad hoc* experiments.

Recent developments in materials modeling and computation developed under the sponsorship of the initial AFOSR MEANS theme and the DARPA Accelerated Insertion of Materials (AIM) program (<http://www.darpa.mil/dso/thrust/matdev/aim.htm>) have initiated the development of critical links in the concurrent design of materials and processes. Integration of these techniques into the design process for airframe structures and gas turbine engines has begun. Now is the time for an interdisciplinary effort to expand the present approaches to integrating materials and systems design to develop robust collaborative strategies and improved physics-based modeling techniques that are capable of continuing to close the gaps between the regimes that separate both the time and size scale domains and selectively using experiments to verify the accuracy of predictions. The critical task in the further development of this approach is the fusion of materials modeling and computational tools, complemented by selective experimentation, into a spectrum of interoperable materials models extending from *ab initio* principles to the development of information required for systems design processes, creating a seamless interface with databases required for engineering design applications. Techniques for uncertainty modeling, lifetime assessment and prediction must accompany this development as an integral part of the overall design strategy.

This program envisions the development of robust materials systems design processes driven by product requirements. Strategies developed will employ generic techniques for coupling calculations and measurements of thermodynamic, structural and kinetic properties of materials with models of microstructural entities that determine macroscopic behavior. Models will employ concepts that link microscale and mesoscale models with continuum descriptions of material behavior and techniques that employ these descriptions to calculate properties of materials and integrate the results into engineering design software. Uncertainty modeling leading to lifetime prediction and assessment models must be an integral part of this development. Modeling at all levels must be accompanied by critical experiments designed to verify analytical predictions and techniques for estimating the reliability and scatter of the computed properties. Emphasis throughout will be on the reduction of empiricism and *ad hoc* assumptions and the compatibility of each model with those for adjacent length

and time scales. Principal goals of this effort are to develop improved design methodologies for structural materials and manufacturing processes by combining experimental and modeling tools from the atomic scale, through the meso scale, and up to the system scale while simultaneously controlling or predicting material reliability issues related to performance.

**Objective:** To develop validated and verified design methodologies that employ materials modeling and strategic experimentation spanning length and time scales from individual atoms to engineering structures, emphasizing compatibility between models at adjacent scales, interoperability with systems design software, lifetime prediction and uncertainty modeling.

**Research Concentration Areas:** The emphasis of this program is on materials used for structural applications, including metals, ceramics, and composites based on polymeric (PMC), metallic (MMC), and ceramic (CMC) matrices, and their hybrids. Integrated Materials Design Teams (IMDT) whose membership will be drawn from university, AFRL laboratory and industrial environments that collectively represent materials science and engineering, engineering and systems design will conduct research described in this BAA. Each participating team will establish an Engineering Focus Area (EFA) for the application of the design process being developed. The EFA selected by each team should be sufficiently broad to encompass a variety of engineering components employed in AF weapons systems, although not all conceivable applications or materials need be addressed by the proposed research. The research conducted by each team will be continuously monitored and periodically reviewed by a coordination committee composed of at least one member each from the principal research participants, a collaborating AFRL Technical Directorate and a manufacturing concern actively engaged in producing components within the EFA. Appropriate EFAs and associated AFRL Technical Directorates include, *but are not limited to*, the following:

Airframe structures (VA, ML)

Propulsion systems (PR, ML)

Munitions (MN, ML)

Spacecraft structures (VS, ML)

Overall program objectives may include *but are not limited to*: development of a strategy for integrating models of PMC that describe resin and fiber properties, processability prediction, quality control, component performance and life cycle cost and prediction; a virtual design and manufacturing system complemented by an intelligent material selection system; design of processes for producing ceramic materials and components for application at ultra high temperatures; design of an aircraft gas turbine engine component optimized for performance, reliability, and affordability; design for integration of dissimilar structural materials for thermal management of aircraft and space vehicles.

Research Concentration Areas (RCA) will be defined by each IMDT in the research plan to support the overall goals of the program. Examples of RCAs include, *but are not limited to*, such topics as: quantitative determination of microstructural features in a form suitable for inclusion in constitutive equations, constitutive equation development that incorporates microstructural features, process models designed to produce specific microstructures and material behavior, calculations of atomic arrangements around defects, models of material behavior that span several length and time scales, life prediction models for polymer matrix composites (PMC) based on degradation mechanisms rather than empirical accelerated aging data, models to predict resin properties of PMC based on formulation and chemical compositions, models that describe the prepregging operation, processing models for cure kinetics, resin flow and consolidation of PMC, micromechanical models describing the ply properties, lay-up sequence, fiber-matrix interface in PMC, systems optimization, computational methods and computationally assisted design of structural ceramic materials, computational design of rainbow thermal protection systems consisting of PMC, metals and ceramics, physics-based design of PMC-metal interface for joints and hybrid laminates.

**Impact:** Research is required to develop and verify tools that will minimize expensive and redundant experimentation for the generation of Designer Knowledge Bases (DKBs) and will permit parallel, global design to replace serial design throughout the product development cycle. Projects in this program will provide basic knowledge necessary for further development and implementation of techniques for the incorporation of materials design into product design, such as those developed under sponsorship of the DARPA Accelerated Insertion of Materials (AIM) program. Implementation of these techniques will permit more rapid development and insertion of reliable and appropriate materials into the manufacture of engineering structures. Results will be more reliable and affordable components required for accomplishment of the Air Force mission.

#### Bidders Conference

On 3 May 2004 a bidders' conference will be held from 0800 to 1200 at the Holiday Inn, Arlington, VA (<http://www.holidayinnarlingtonva.com/>) to permit prospective bidders to meet with Program Managers and representatives of AFRL Technical Directorates. At this meeting program managers will be available to clarify program objectives. In addition, prospective bidders are encouraged to use this meeting to explore potential collaborations among universities, manufacturers and AFRL Technical Directorates. Information on registration and logistics for the proposers conference can be obtained from Mr. Raymond Herrera, (703) 696 7317 ([raymond.herrera@afosr.af.mil](mailto:raymond.herrera@afosr.af.mil))

#### Letter of Intent

Following the bidders' conference prospective bidders are requested to submit to the appropriate Program Manager no later than 1 June, 2004 a letter of intent describing in four pages or less the proposed research program. The letter

should state the program objectives and identify participants in the Integrated Materials Design Team, the Engineering Focus Area and Research Concentration areas. A summary of the anticipated total project cost should also be included. The cognizant program manager will respond to letters of intent no later than 30 Jun 2004 with comments concerning the suitability of the proposed project for the program.

## **II. Award Information**

The anticipated types of awards are project grants, cooperative agreements or contracts. Individual projects may receive funding up to \$750 K per year for a maximum of three years.

## **III. Eligibility Information**

### **1. Eligible Applicants** – This competition is open to all respondents.

Proposals are encouraged from historically Black colleges and universities and minority institutions (HBCU/MI), as defined by 10 U.S.C. 2323. Accredited U.S. postsecondary institutions that meet the statutory criteria for identification as minority institutions are listed at the following Department of Education web site: [www.ed.gov/offices/OCR/minorityinst.html](http://www.ed.gov/offices/OCR/minorityinst.html). However, no funds are specifically allocated for HBCU/MI participation.

### **2. Cost Sharing or Matching** – Cost Sharing is not required.

**3. Other** – There are no limits to the number of applications an applicant may submit.

## **IV. Application and Submission Information**

**1. Address to Request Application Package:** Consult the AFOSR web page: [www.afosr.af.mil](http://www.afosr.af.mil). Directly under the AFOSR logo on the home page is “Doing Business with AFOSR”. The first listing under this topic is “How to Apply for a Grant or Contract”. Full details of proposal content and form are given there. Download and complete the proposal Cover Page. In the block “Title of Proposed Project”, add the following:

- Solicitation Title: Theme 2005 - Materials Engineering for Affordable New Systems II (MEANS2).

**2. Content and Form of Application Submission:** Prepare three 12-month budgets (the second being an optional final year) beginning 01 November 2004, the anticipated start date of successful applications. Proposals of more than 30 total pages of technical content are discouraged. Vita of key personnel should be limited to two pages per person.

An original and five copies of the proposal should be mailed to:

AFOSR/NA  
4015 Wilson Blvd, Room 713  
Arlington, VA 22203-1954

Attn: MEANS II

**3. Submission Dates and Time:** To receive maximum consideration proposals should be received at AFOSR by 3:00 PM, EST, 12 August 2004.

**4. Intergovernmental Review:** None

**5. Funding Restrictions:** None

**6. Other Submission Requirements.** Only hard copy submissions will be accepted. Proposals may also be submitted by electronic media (floppy disk, zip disk or CD-ROM in MS Word or Portable Document File (PDF) format).

#### Format and Technical Content Proposals

Each proposal should be typed single sided in 10 or 12-point, double-spaced, on 8 1/2 X 11 inch white paper, bound or stapled to keep documents intact and allow convenient handling. Attachments, such as institutional brochures or reprints, will not be considered in the evaluation or selection process. The proposed objective should be the performance of research in support of the program goals delineated in Section II. For this reason, proposals must adequately describe the proposed research (including current state-of-the-art, recent contributions of the proposer, intended technical approach and expected results) objectives, approach and expected outcomes. This information will allow evaluation of prospective research quality and relevance.

1. Cover Page. To be eligible for consideration, each copy of the proposal should bear as a cover page provided in Appendix A (or a photocopy thereof). The original proposal and each copy must include these pages.

2. Abstract. The abstract of the proposal should be no more than one page long.

3. Text. The technical portion of the proposal must contain the following:

a. A conceptual outline of research goals and proposed scientific approaches identifying novel or innovative features.

b. Describe in detail the research to be undertaken. State the objectives, approach and relationship to the current state of knowledge. Include an appropriate bibliography and list of literature citations. Summarize the expected research results and significance as well as the expected contribution toward meeting the objectives of the program outlined in Section II.

c. Estimate the time that each principal investigator and other senior professional

personnel will devote to the research. For research teams describe the task breakdown and research responsibilities of each constituent unit.

d. Describe facilities available for performing the proposed research and any additional facilities or equipment proposed for acquisition.

4. Curriculum Vitae. Furnish brief vitae for key research personnel, including senior investigators. Provide biographical sketches and list relevant publications. *Vita* should be limited to two pages for each investigator. List names and titles of other scientific or technical personnel who will be directly associated with the project.

### C. Financial Content of Proposal

The financial portion of the proposal must contain a cost estimate for the proposed effort including a description of cost sharing arrangements, if any. It is anticipated that the awards will have a performance period of thirty-six months. For evaluation purposes budgets should be for each twelve-month period. Assume a 1 November 2004 effective date. AFOSR will make payment to educational and non-profit recipients based upon a predetermined payment schedule. Payments will normally be made quarterly in advance of performance, based upon a spending profile that must be provided as part of the proposal. Payments should be limited to the amounts needed to conduct research during each respective period. Educational and non-profit organizations shall submit a spending profile with their cost proposal. For further details, proposers should refer to the "Proposer's Guide to AFOSR Research Programs" (see Section V J for availability).

### V. Application Review Information

**1. Criteria:** Proposals under this Broad Agency Announcement (BAA) will be evaluated through a peer or scientific review process, and selected for award on a competitive basis according to Public Law 98-369, Competition in Contracting Act of 1984, 10 U S C 2361, and 10 U S C 2374. All other proposals will be evaluated under the following two primary criteria, of equal importance, as follows:

1. The scientific and technical merits of the proposed research in the context of the objectives of the theme
2. The potential contributions of the proposed RCA (Research Focus Area) and the potential insertion through IMDT (Integrated Material Design Team) to the mission of the Air Force.

Other evaluation criteria used in the technical reviews, which are of lesser importance than the primary criteria and of equal importance to each other, are as follows:

1. The likelihood of the proposed effort to develop new research capabilities and broaden the research base in support of U.S. national defense.
2. Qualification, capabilities and related experience of key personnel,



facilities, or techniques or a combination of these factors that is integral to achieving USAF objectives.

3. The proposer's and associated personnel's record of past performance.
4. The realism and reasonableness of proposed costs and availability of funds.

No further evaluation criteria will be used in source selection. The technical and cost information will be analyzed simultaneously during the evaluation process.

## **VI. Award Administration Information:**

**1. Award Notices:** Principal Investigators of successful proposals will receive a notice, by letter or e-mail, on or about 1 Oct 2004. For those proposals being recommended for an award, the notification should not be regarded as an authorization to commit or expend funds. Proposals selected for funding as grants or cooperative agreements except at the recipient's own risk, to the extent that the recipient allows charging to awards of 90 days pre-award costs). Negotiations may result in funding levels that are less than proposed. Only an award document signed by a Government Contracting/Grants Officer will bind the Government.

**2. Administrative Requirements:** AFOSR's terms and conditions for grants are available at the AFOSR web page: [www.afosr.af.mil](http://www.afosr.af.mil). Directly under the AFOSR logo on the home page is "Doing Business with AFOSR".

**3. Reporting:** A performance report will be due to AFOSR each year on September 01 and a final technical report will be due after completion of the research. For report content see ([www.afosr.af.mil/pdfs/performance-reports/March2000.pdf](http://www.afosr.af.mil/pdfs/performance-reports/March2000.pdf)). For grants and cooperative agreements, Financial Report using SF-269 (or SF-272) is required by Part 32 of the DoD Grant and Agreement Regulations (32 CFR part 32).

## **VII. Agency Contract(s):** Address questions to:

MEANS Theme Program Managers:

Dr. Craig S. Hartley (703) 696-8523, [craig.hartley@afosr.af.mil](mailto:craig.hartley@afosr.af.mil) (**Theme Coordinator** and Metallic Materials),

Dr. Charles Y.-C. Lee, (703) 696-7779, [charles.lee@afosr.af.mil](mailto:charles.lee@afosr.af.mil) (Organic Matrix Composites)

Dr. Joan Fuller (703) 696-7236, [joan.fuller@afosr.af.mil](mailto:joan.fuller@afosr.af.mil) (Ceramics and Non-metallic Materials)

Dr. Byung-lip Lee (703) 696-8483; [byunglip.lee@afosr.af.mil](mailto:byunglip.lee@afosr.af.mil), (Mechanics of Materials and Devices).

## **APPENDIX A: PROPOSAL COVER**

**(Complete and submit with the Proposal)**

### **SUBMITTED TO MEANS 2**

**Proposal No:** \_\_\_\_\_  
**(To Be Completed by Agency Only)**

#### **1. THE PRINCIPAL INVESTIGATOR (one name only):**

\_\_\_\_\_  
(Title) (First Name) (MI) (Last Name) (Signature – please use blue ink)

\_\_\_\_\_  
(Phone Number, Including Area Code) (Fax Number) (E-mail address)

\_\_\_\_\_  
(Organization)

\_\_\_\_\_  
(Department/Division)

\_\_\_\_\_  
(Street/P.O. Box)

\_\_\_\_\_  
(City) (State) (Zip Code)

CURRENT DoD CONTRACTOR OR GRANTEE? YES \_\_\_ NO \_\_\_ If yes, give Agency, Contract Number, Point of Contact, Phone Number:

#### **2. THE PROPOSAL:**

\_\_\_\_\_  
(Title of the Proposal)

\_\_\_\_\_  
Total Funds Requested 1 November 2004 to \_\_\_\_\_  
From DoD Proposed Date Your Institution's  
Proposal Number

\_\_\_\_\_  
Primary reviewing agency and relevant Division/Directorate/Office or technical area/program officer

#### **OTHER AGENCIES RECEIVING THIS FUNDING REQUEST**

[e.g., NSF, DOE, NASA, NIH, or other] Please identify agency(ies) and give Name(s) and Phone Number(s) of Point(s) of Contact at those agencies:

**3. CERTIFICATIONS:** By signing and submitting this proposal, the proposer is providing the certification at Appendix A to 32 CFR Part 25 regarding debarment, suspension, and other matters; the certification at Appendix C to 32 CFR Part 25 regarding drug-free workplace; and the certification at Appendix A to 32 CFR Part 28 regarding lobbying.

**4. MINORITY INSTITUTION:** \_\_\_\_\_ Check here if the academic institution named above is qualified to be identified by the Department of Education as a minority institution (i.e., a historically Black college or university, Hispanic-serving institution, Tribal college or university, or other institution meeting statutorily-defined criteria for serving ethnic groups that are underrepresented in science and engineering). The Department of Education maintains the list of U.S. accredited postsecondary institutions that currently meet the statutory criteria for identification as minority institutions at the following web site:

<http://www.ed.gov/offices/OCR/minorityinst.html>

**5. A. INTEGRATED MATERIALS DESIGN TEAM Point of Contact**

**B. RESEARCH FOCUS AREA**

**C. ENGINEERING FOCUS AREA**

**6. THE INSTITUTION**

NAME AND ADDRESS OF UNIVERSITY OFFICIAL AUTHORIZED TO OBLIGATE CONTRACTUALLY:

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(Title)	(First Name)	(MI)	(Last Name)	(Phone Number, Including Area Code)
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Name of Grantee (University)	(Fax Number)
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Street Address (P.O. Box Numbers Cannot Be Accepted)	(E-mail address)
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(City)	(State)	(Zip Code)
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DUNS + 4 No.<sup>1</sup> \_\_\_\_\_

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Signature of Authorized University Official  
(Please use blue ink)

<sup>1</sup> The institution's number in the data universal numbering system or DUNS+4 is a unique 13-character identification number for organizations and subsidiaries. Dun & Bradstreet Corporation assigns these numbers. You can receive a DUNS+4 number by calling Dun & Bradstreet at 1(800) 333-0505 or go to the Dun & Bradstreet Web site at <http://www.dnb.com/dunsno/list.htm>. To facilitate payment under any award, the institution must be registered in the Central Contract Registry (CCR). CCR uses the DUNS+4 as a unique identifier for each organization. Information on registering in the CCR may be found at <http://www.ccr.com/> or 1-(888) 227-2423.